

10 density which is lower than the high recording density, the distinguishing information informing
11 that the first region of the information recording substrate has the first thickness T1.

1 87 (Amended). In combination with a compound objective lens according to any one of
2 claims 133-136, an optical disk, comprising:

3 an information recording substrate having a thin thickness, the thin thickness of the
4 information recording substrate being thinner than that of a compact disk;

5 a plurality of first recording pits placed at a first region of the information recording
6 substrate for recording pieces of recording information at a high recording density; and

7 a plurality of second recording pits placed at a second region of the information recording
8 substrate for recording pieces of distinguishing information at a low recording density, the
9 distinguishing information informing that the first region of the information recording substrate
10 has the thin thickness.

1 88 (Amended). In combination with a compound objective lens according to any one of
2 claims 133-136, an optical disk apparatus, comprising:

3 rotating means for rotating an information medium which has a first thickness T1 or a
4 second thickness T2 larger than the first thickness T1;

5 an optical head apparatus including the compound objective lens for reading an
6 information signal, a focus error signal and a tracking error signal from the information medium
7 rotated by the rotating means through the objective lens;

8 moving means for moving the optical head apparatus;

9 connecting means for connecting the rotating means and the moving means with an
10 electric source to supply an electric power to the rotating means and the moving means;

11 actuating means for actuating the objective lens of the optical head apparatus;

12 focus control means for controlling the actuating means to perform a first focus control of
13 the optical head apparatus corresponding to the first thickness T1 of the information medium and
14 a second focus control of the optical head apparatus corresponding to the second thickness T2 of
15 the information medium according to the focus error signal read by the optical head apparatus;

16 tracking control means for controlling the actuating means to perform a first tracking
17 control of the optical head apparatus corresponding to the first thickness T1 of the information
18 medium and a second tracking control of the optical head apparatus corresponding to the second

19 thickness T2 of the information medium according to the tracking error signal read by the optical
20 head apparatus;

21 detecting means for detecting whether the information medium has the first thickness T1
22 or the second thickness T2; and

23 changing means for switching from the second focus and tracking controls performed by
24 the focus control means and the tracking control means to the first focus and tracking controls
25 performed by the focus control means and the tracking control means according to the detection
26 of the detecting means.

1 106 (Amended). A microscope including the compound objective lens having a plurality
2 of focal points according to any of claims 133-136, further comprising:

3 an ocular lens for receiving a beam of light from a plurality of planes through the lens
4 and observing the planes, the planes being placed at a plurality of positions different in an optical
5 axis direction.

1 107 (Amended). A microscope including the compound objective lens having a plurality
2 of focal points according to any of claims 133-136, further comprising:

3 photographing means for receiving beam of light from a plurality of planes through the
4 lens and photographing the planes, the planes being placed at a plurality of positions different in
5 an optical axis direction.

1 108 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an exposing apparatus comprising:

3 an alignment light source for radiating a plurality of beams of alignment light to
4 illuminate a photomask and a sample placed at different points in an optical axis direction;
5 said compound objective lens refracting the alignment light generated by the light source
6 and diverging from the photomask and the sample;

7 light superposing means for superposing the alignment light refracted by the lens to form
8 a beam of superposed light;

9 ocular lens for converging the superposed light generated by the light superposing means;
10 aligning means for aligning the photomask and the sample according to the superposed
11 light photographed by the photographing means;

12 an exposure light for radiating a beam of exposure light; and
13 exposing means for exposing a photo sensitive material coated on the sample which is
14 aligned with the photomask by the aligning means.

1 109 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an exposing apparatus comprising:

3 an alignment light source for radiating a plurality of beams of alignment light to
4 illuminate a photomask and a sample placed at different points in an optical axis direction;
5 said compound objective lens refracting the alignment light generated by the light source
6 and diverging from the photomask and the sample;

7 light superposing means for superposing the alignment light refracted by the lens to form
8 a beam of superposed light;

9 photographing means for photographing the superposed light generated by the light
10 superposing means;

11 aligning means for aligning the photomask and the sample according to the superposed
12 light converged by the ocular lens;

13 an exposure light source for radiating a beam of exposure light; and
14 exposing means for exposing a photo sensitive material coated on the sample which is
15 aligned with the photomask by the aligning means to the exposure light radiated from the
16 exposure light source.

1 110. (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an image reproducing apparatus, comprising:

3 rotating means for rotating an information medium which has a first thickness T1 or a
4 second thickness T2 larger than the first thickness T1;

5 an optical head apparatus including the compound objective lens for converging a beam
6 of incident light at a plurality of focal points and reading an image information signal, a focus
7 error signal and a tracking error signal from the information medium rotated by the rotating
8 means;

9 moving means for moving the optical head apparatus;

10 connecting means for connecting the rotating means and the moving means with an
11 electric source to supply an electric power to the rotating means and the moving means;

12 actuating means for actuating the compound objective lens of the optical head apparatus;

13 focus control means for controlling the actuating means to perform a first focus control of
14 the optical head apparatus corresponding to the first thickness T1 of the information medium and
15 a second focus control of the optical head apparatus corresponding to the second thickness T2 of
16 the information medium according to the focus error signal read by the optical head apparatus;

17 tracking control means for controlling the actuating means to perform a first tracking
18 control of the optical head apparatus corresponding to the first thickness T1 of the information
19 medium and a second tracking control of the optical head apparatus corresponding to the second
20 thickness T2 of the information medium according to the tracking error signal read by the optical
21 head apparatus; and

22 displaying means for reproducing the image information signal read by the optical head
23 apparatus as an image.

1 111 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, a voice reproducing apparatus, comprising:

3 rotating means for rotating an information medium which has a first thickness T1 or a
4 second thickness T2 larger than the first thickness T1;

5 an optical head apparatus including the compound objective lens for converging a beam
6 of incident light at a plurality of focal points and reading a voice information signal, a focus error
7 signal and a tracking error signal from the information medium rotated by the rotating means;

8 moving means for moving the optical head apparatus;

9 connecting means for connecting the rotating means and the moving means with an
10 electric source to supply an electric power to the rotating means and the moving means;

11 actuating means for actuating the compound objective lens of the optical head apparatus;

12 focus control means for controlling the actuating means to perform a first focus control of
13 the optical head apparatus corresponding to the first thickness T1 of the information medium and
14 a second focus control of the optical head apparatus corresponding to the second thickness T2 of
15 the information medium according to the focus error signal read by the optical head apparatus;

16 tracking control means for controlling the actuating means to perform a first tracking
17 control of the optical head apparatus corresponding to the first thickness T1 of the information
18 medium and a second tracking control of the optical head apparatus corresponding to the second
19 thickness T2 of the information medium according to the tracking error signal read by the optical
20 head apparatus; and

21 voice reproducing means for reproducing the voice information signal read by the optical
22 head apparatus as voices.

1 112 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an information processing apparatus, comprising:

3 rotating means for rotating an information medium which has a first thickness T1 or a
4 second thickness T2 larger than the first thickness T1;

5 an optical head apparatus including the compound objective lens for converging a beam
6 of incident light at a plurality of focal points and reading an information signal, a focus error
7 signal and a tracking error signal from the information medium rotated by the rotating means;

8 moving means for moving the optical head apparatus;

9 connecting means for connecting the rotating means and the moving means with an
10 electric source to supply an electric power to the rotating means and the moving means;
11 actuating means for actuating the objective lens of the optical head apparatus;

12 focus control means for controlling the actuating means to perform a first focus control of
13 the optical head apparatus corresponding to the first thickness T1 of the information medium and
14 a second focus control of the optical head apparatus corresponding to the second thickness T2 of
15 the information medium according to the focus error signal read by the optical head apparatus;

16 tracking control means for controlling the actuating means to perform a first tracking
17 control of the optical head apparatus corresponding to the first thickness T1 of the information
18 medium and a second tracking control of the optical head apparatus corresponding to the second
19 thickness T2 of the information medium according to the tracking error signal read by the optical
20 head apparatus; and

21 information processing means for processing the information signal read by the optical
22 head apparatus as an image.

1 113 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical head apparatus, comprising:

3 a light source for radiating a beam of incident light;

4 a first optical disk having a transparent substrate of a first thickness T1 and an information
5 recording plane;

6 a second optical disk having a transparent substrate of a second thickness T2 lower than
7 the first thickness T1 (T2<T1) and an information recording plane;

8 the compound objective lens, partitioned into a plurality of light passing regions
9 including a first light passing region and a second light passing region respectively
10 corresponding to a distance from an optical axis of the beam of incident light radiated from the
11 light source, receiving the beam of incident light radiated from the light source, converging the
12 beam of incident light, which passes through the second light passing region and the transparent
13 substrate of the second optical disk, at the information recording plane of the second optical disk,
14 and converging the beam of incident light, which passes through the first light passing region and
15 the transparent substrate of the first optical disk, at the information recording plane of the first
16 optical disk; and

17 a photo detector for detecting the beam of incident light, which is converged at the
18 information recording plane of the first optical disk and the information recording plane of the
19 second optical disk by the objective lens and is reflected by the first optical disk and the second
20 optical disk, to obtain first information recorded in the information recording plane of the first
21 optical disk and second information recorded in the information recording plane of the second
22 optical disk.

1 115 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical disk apparatus, comprising:
3 a light source for radiating a beam of incident light;
4 a first optical disk having a transparent substrate of a first thickness T1 and an information
5 recording plane;
6 a second optical disk having a transparent substrate of a second thickness T2 lower than
7 the first thickness T1 (T2<T1) and an information recording plane;
8 rotating means for rotating the first optical disk or the second optical disk;
9 an optical head apparatus, which comprises
10 the compound objective lens, partitioned into a plurality of light passing regions
11 including a first light passing region and a second light passing region respectively
12 corresponding to a distance from an optical axis of the beam of incident light radiated from the
13 light source, for receiving the beam of incident light radiated from the light source, converging
14 the beam of incident light, which passes through the second light passing region and the
15 transparent substrate of the second optical disk, at the information recording plane of the second
16 optical disk, and converging the beam of incident light, which passes through the first light

17 passing region and the transparent substrate of the first optical disk, at the information recording
18 plane of the first optical disk; and

19 a photo detector for detecting the beam of incident light which is converged at the
20 information recording plane of the first optical disk or the information recording plane of the
21 second optical disk by the compound objective lens and is reflected by the first optical disk or
22 the second optical disk;

23 focus control means for performing a first focus control of the optical head apparatus
24 corresponding to the first thickness T1 of the first optical disk and a second focus control of the
25 optical head apparatus corresponding to the second thickness T2 of the second optical disk
26 according to the beam of incident light detected by the photo detector;

27 tracking control means for performing a first tracking control of the optical head
28 apparatus corresponding to the first thickness T1 of the first optical disk and a second tracking
29 control of the optical head apparatus corresponding to the second thickness T2 of the second
30 optical disk according to the beam of incident light detected by the photo detector; and

31 information detecting means for judging according to the beam of incident light detected
32 by the photo detector of the optical head apparatus, for which the first focus control and the
33 second focus control of the focus control means and the first tracking control and the second
34 tracking control of the tracking control means are performed, whether the beam of incident light
35 radiated from the light source is converged at the information recording plane of the first optical
36 disk or the information recording plane of the second optical disk, reproducing first information
37 recorded in the information recording plane of the first optical disk from the beam of incident
38 light detected by the photo detector in cases where it is judged that the beam of incident light
39 radiated from the light source is converged at the information recording plane of the first optical
40 disk, and reproducing second information recorded in the information recording plane of the
41 second optical disk from the beam of incident light detected by the photo detector in cases where
42 it is judged that the beam of incident light radiated from the light source is converged at the
43 information recording plane of the second optical disk, and

44 moving means for moving the optical head apparatus.

1 116 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical head apparatus, comprising:
3 a laser light source for radiating a beam of incident light;

4 a first information medium having an information recording plane and a transparent
5 substrate of a first thickness T1, a thickness of the first information medium being set to T1;
6 a second information medium having an information recording plane and a transparent
7 substrate of a second thickness T2 smaller than the first thickness T1 (T2<T1), a thickness of the
8 second information medium being set to T2; and
9 a light focusing optical system, in which the compound objective lens comprises:
10 a first lens region, corresponding to a numerical aperture NA1, for focusing the beam of
11 incident light radiated from the laser light source on the information recording plane of the first
12 information medium through the transparent substrate of the first information medium as a light
13 spot for the purpose of reading out first information from the first information medium;
14 a second lens region, corresponding to a numerical aperture NA2 higher than the
15 numerical aperture NA1 (NA1<NA2), for focusing the beam of incident light radiated from the
16 laser light source on the information recording plane of the second information medium through
17 the transparent substrate of the second information medium as a light spot for the purpose of
18 reading out second information from the second information medium; and
19 a third lens region which corresponds to a numerical aperture NA3 satisfying
20 NA1≤NA3<NA2 and is unified with the second lens region of the compound objective lens
21 through a discontinuous plane.

1 122 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical disk apparatus, comprising:
3 a laser light source for radiating a beam of incident light;
4 a first information medium having an information recording plane and a transparent
5 substrate of a first thickness T1, a thickness of the first information medium being set to T1;
6 a second information medium having an information recording plane and a transparent
7 substrate of a second thickness T2 smaller than the first thickness T1 (T2<T1), a thickness of the
8 second information medium being set to T2;
9 rotating means for rotating the first information medium or the second information
10 medium;
11 an optical head apparatus, which comprises
12 a light focusing optical system, in which the compound objective lens comprises:

13 a first lens region, corresponding to a numerical aperture NA1, for focusing the beam of
14 incident light radiated from the laser light source on the information recording plane of the first
15 information medium through the transparent substrate of the first information medium as a light
16 spot for the purpose of reading out first information from the first information medium;

17 a second lens region, corresponding to a numerical aperture NA2 higher than the
18 numerical aperture NA1 (NA1<NA2), for focusing the beam of incident light radiated from the
19 laser light source on the information recording plane of the second information medium through
20 the transparent substrate of the second information medium as a light spot for the purpose of
21 reading out second information from the second information medium; and

22 a third lens region which corresponds to a numerical aperture NA3 satisfying
23 NA1≤NA3<NA2 and is unified with the second lens region of the objective lens through a
24 discontinuous plane;

25 focus control means for performing a first focus control of the optical head apparatus
26 corresponding to the first thickness T1 of the first information medium and a second focus
27 control of the optical head apparatus corresponding to the second thickness T2 of the second
28 information medium according to the beam of incident light detected by the photo detector;

29 tracking control means for performing a first tracking control of the optical head
30 apparatus corresponding to the first thickness T1 of the first information medium and a second
31 tracking control of the optical head apparatus corresponding to the second thickness T2 of the
32 second information medium according to the beam of incident light detected by the photo
33 detector; and

34 information detecting means for judging according to the beam of incident light detected
35 by the photo detector of the optical head apparatus, for which the first focus control and the
36 second focus control of the focus control means and the first tracking control and the second
37 tracking control of the tracking control means are performed, whether the beam of incident light
38 radiated from the light source is converged at the information recording plane of the first
39 information medium or the information recording plane of the second information medium,
40 reproducing the first information recorded in the information recording plane of the first
41 information medium from the beam of incident light detected by the photo detector in cases
42 where it is judged that the beam of incident light radiated from the light source is converged at
43 the information recording plane of the first information medium, and reproducing the second
44 information recorded in the information recording plane of the second information medium from

45 the beam of incident light detected by the photo detector in cases where it is judged that the beam
46 of incident light radiated from the light source is converged at the information recording plane of
47 the second information medium; and
48 moving means for moving the optical head apparatus.

1 126 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical head apparatus, comprising:

3 a light source for radiating a beam of incident light;

4 a first information medium having an information recording plane and a transparent
5 substrate of a first thickness T1 a thickness of the first information medium being set to T1;
6 a second information medium having an information recording plane and a transparent
7 substrate of a second thickness T2 smaller than the first thickness T1 (T2<T1), a thickness of the
8 second information medium being set to T2;

9 a light focusing optical system for receiving the beam of incident light radiated from the
10 light source and focusing the beam of incident light on the information recording plane of the
11 first information medium or the second information medium through the transparent substrate of
12 the first thickness T1 or the transparent substrate of the second thickness T2 to read out
13 information recorded in the first information medium or the second information medium, the
14 light focusing optical system comprising

15 a phase adjusting device, formed in a ring-band shape, for shifting a part of the beam of
16 incident light radiated from the light source, and

17 wherein the compound objective lens, has a light converging performance so as to
18 converge the beam of incident light radiated from the light source on the information recording
19 plane of the second information medium through the transparent substrate of the second
20 thickness T2 at a diffraction limit, for converging the beam of incident light, of which the part is
21 shifted by the phase adjusting device, on the information recording plane of the first information
22 medium or the second information medium through the transparent substrate of the first
23 thickness T1 or the transparent substrate of the second thickness T2; and

24 a photo detector for detecting the beam of incident light, which is converged on the
25 information recording plane of the first information medium or the information recording plane
26 of the second information medium by the light focusing optical system and is reflect by the first
27 information medium or the second information medium, to reproduce information recorded in
28 the first information medium or the second information medium.

1 130 (Amended). A compound objective lens according to any of claims 133-136, wherein
2 the compound objective lens includes:P:

3 a first lens region, corresponding to a first numerical aperture NA1, for focusing a beam
4 of incident light, which is radiated from a laser light source and transmits through a transparent
5 substrate of a first information medium having a first thickness T1, to form a light spot on an
6 information recording plane of the first information medium for the purpose of reading out
7 information from the first information medium;

8 a second lens region, corresponding to a second numerical aperture NA2 higher than the
9 first numerical aperture NA1 (NA1<NA2), for focusing the beam of incident light, which is
10 radiated from the laser light source and transmits through a transparent substrate of a second
11 information medium having a second thickness T2 smaller than the first thickness T1 (T2<T1), to
12 form a light spot on an information recording plane of the second information medium for the
13 purpose of reading out information from the second information medium; and

14 a third lens region, corresponding to a numerical aperture NA4 equal to or lower than the
15 numerical aperture NA1 (NA4≤NA1), for changing the beam of incident light radiated from the
16 laser light source to converge the beam of incident light on the information recording plane of
17 the first information medium through the transparent substrate of the first information medium
18 having the first thickness T1.

1 131 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical head apparatus, comprising:

3 a laser light source for radiating a beam of incident light;
4 a first information medium having an information recording plane and a transparent
5 substrate of a first thickness T1, a thickness of the first information medium being set to T1;
6 a second information medium having an information recording plane and a transparent
7 substrate of a second thickness T2 smaller than the first thickness T1 (T2<T1), a thickness of the
8 second information medium being set to T2; and

9 a light focusing optical system, in which the compound objective lens comprises:
10 a first lens region, corresponding to a numerical aperture NA1, for focusing the beam of
11 incident light radiated from the laser light source on the information recording plane of the first

12 information medium through the transparent substrate of the first information medium as a light
13 spot for the purpose of reading out first information from the first information medium;

14 a second lens region, corresponding to a numerical aperture NA2 higher than the
15 numerical aperture NA1 (NA1<NA2), for focusing the beam of incident light radiated from the
16 laser light source on the information recording plane of the second information medium through
17 the transparent substrate of the second information medium as a light spot for the purpose of
18 reading out second information from the second information medium; and

19 a third lens region, corresponding to a numerical aperture NA4 equal to or lower than the
20 numerical aperture NA1 (NA4≤NA1), for changing the beam of incident light radiated from the
21 laser light source to converge the beam of incident light on the information recording plane of
22 the first information medium through the transparent substrate of the first information medium
23 having the first thickness T1; and

24 a photo detector for detecting the beam of incident light, which is converged on the
25 information recording plane of the first information medium or the information recording plane
26 of the second information medium by the light focusing optical system and is reflect by the first
27 information medium or the second information medium, to reproduce the first information
28 recorded in the first information medium or the second information recorded in the second
29 information medium.

1 132 (Amended). In combination with a compound objective lens according to any of
2 claims 133-136, an optical disk apparatus, comprising:

3 a laser light source for radiating the beam of incident light having a particular
4 wavelength;

5 a first information medium, having an information recording plane and a transparent
6 substrate of a first thickness T1, for recording first information on the information recording
7 plane, a thickness of the first information medium being set to T1;

8 a second information medium, having an information recording plane and a transparent
9 substrate of a second thickness T2 smaller than the first thickness T1 (T2<T1), for recording
10 second information on the information recording plane, a thickness of the second information
11 medium being set to T2;

12 rotating means for rotating the first information medium or the second information
13 medium;

14 an optical head apparatus, which comprises
15 a light focusing optical system, in which the compound objective lens comprises:
16 a first lens region, corresponding to a numerical aperture NA1, for focusing the beam of
17 incident light radiated from the laser light source on the information recording plane of the first
18 information medium through the transparent substrate of the first information medium as a light
19 spot for the purpose of reading out first information from the first information medium;

20 a second lens region, corresponding to a numerical aperture NA2 higher than the
21 numerical aperture NA1 (NA1<NA2), for focusing the beam of incident light radiated from the
22 laser light source on the information recording plane of the second information medium through
23 the transparent substrate of the second information medium as a light spot for the purpose of
24 reading out second information from the second information medium; and

25 a third lens region, corresponding to a numerical aperture NA4 equal to or lower than the
26 numerical aperture NA1 (NA4≤NA1), for changing the beam of incident light radiated from the
27 laser light source to converge the beam of incident light on the information recording plane of
28 the first information medium through the transparent substrate of the first information medium
29 having the first thickness T1;

30 focus control means for performing a first focus control of the optical head apparatus
31 corresponding to the first thickness T1 of the first information medium and a second focus
32 control of the optical head apparatus corresponding to the second thickness T2 of the second
33 information medium according to the beam of incident light detected by the photo detector;

34 tracking control means for performing a first tracking control of the optical head
35 apparatus corresponding to the first thickness T1 of the first information medium and a second
36 tracking control of the optical head apparatus corresponding to the second thickness T2 of the
37 second information medium according to the beam of incident light detected by the photo
38 detector; and

39 information detecting means for judging according to the beam of incident light detected
40 by the photo detector of the optical head apparatus, for which the first focus control and the
41 second focus control of the focus control means and the first tracking control and the second
42 tracking control of the tracking control means are performed, whether the beam of incident light
43 radiated from the light source is converged at the information recording plane of the first
44 information medium or the information recording plane of the second information medium,
45 reproducing the first information recorded in the information recording plane of the first

46 information medium from the beam of incident light detected by the photo detector in cases
47 where it is judged that the beam of incident light radiated from the light source is converged at
48 the information recording plane of the first information medium, and reproducing the second
49 information recorded in the information recording plane of the second information medium from
50 the beam of incident light detected by the photo detector in cases where it is judged that the beam
51 of incident light radiated from the light source is converged at the information recording plane of
52 the second information medium; and

53 moving means for moving the optical head apparatus.

1 133 (New). A compound objective lens, in which a light beam passes through a
2 portion of the lens onto an optical disk placed apart from the lens, wherein
3 the portion of the lens is divided into a plurality of regions including at least a first region and a
4 second region depending on differences in distance from an optical axis of the light beam,
5 the first region being optimized so that a light beam passing the first region converges onto an
6 optical disk of a first thickness T1,

7 the second region being optimized so that a light beam passing the second region is
8 converged onto any of the optical disk of the first thickness T1 and an optical disk of a second
9 thickness T2 larger than the thickness T1 ($T2 > T1$), the second region including a hologram, and
10 a relationship of $NA2 < NA1$ being satisfied by locating the first region at a position
11 farther from the optical axis than a position of the second region, where $NA1$ and $NA2$ are
12 numerical apertures of the lens that permit the light beam to converge onto the optical disk of the
13 thicknesses $T1$ and $T2$, respectively.

1 134 (New). A compound objective lens receiving a beam of incident light, comprising:
2 a refraction type of lens passing the beam therethrough and providing a refracted light
3 beam; and
4 a concentric circle relief type of lens, which is placed to receive either the beam of
5 incident light or the refracted light beam, for performing phase modulation on the beam received
6 thereby so as to meet the relationships of
7 $T1 < T2$ and $NA1 > NA2$,
8 wherein a numerical aperture required when the beam is converged at a first focal point
9 after the refraction type of lens, on an optical disk having a thickness of $T1$ is $NA1$ and a further
10 numerical aperture required when the beam is converged at a second focal point, after the
11 refraction type of lens, on a further optical disk having a thickness of $T2$ is $NA2$, respectively.

1 135 (New). A compound objective lens receiving an incident beam light, comprising:
2 a refraction type of lens adapted to pass the beam therethrough and to provide a refracted
3 light beam; and

4 a second lens receiving either the incident light beam or the refracted light beam and
5 adapted to perform phase modulation on a beam received thereby so as to meet the relationships
6 of

7 $T_1 < T_2$ and $NA_1 > NA_2$,
8 wherein a numerical aperture required when the beam received by the second lens is
9 converged at a first focal point on a first receiving object having a thickness of T_1 is NA_1 and a
10 numerical aperture required when the beam received by the second lens is converged at a second
11 focal point on a further receiving object having a thickness of T_2 is NA_2 .

1 136 (New). A compound objective lens receiving a beam of incident light, comprising:
2 a refraction type of lens passing the beam therethrough and providing a refracted light
3 beam; and

4 a concentric circle relief type of lens, which is placed to receive either the beam of
5 incident light or the refracted light beam, for performing phase modulation on the beam received
6 thereby so as to converge the received light beam at different focal points,
7 wherein one of the focal points is equal to or higher than 0.6.

137 (New). The compound objective lens according to claim 133, wherein the first
region includes a further hologram.

138 (New). The compound objective lens according to claim 133, wherein the lens
includes a region excluding a hologram.

1 139 (New). An optical head apparatus including the compound objective lens
2 according to any one of claims 133-136 for performing at least one of recording and
3 reproduction of pieces of information on to and from an optical disk placed to face the optical

4 head apparatus, the optical disk including a first transparent substrate of thickness T1 and a
5 second transparent substrate of thickness T2, comprising:

6 an optical source for radiating a light beam;

7 wherein the compound objective lens receives the light beam radiated by the optical
8 source so as to converge the light beam at micro-spots on the first and second substrates of the
9 optical disk, and wherein the compound objective lens includes

10 a first region optimized so that the light beam passing the first region converges at
11 the micro-spots on the first substrate of smaller thickness of the optical disk,

12 a second region optimized so that the light beam passing the second region is
13 converged at the micro-spots on any of the first and second substrates of the optical disk,
14 the second region including a hologram, and wherein

15 NA1 and NA2 are numeral apertures of the lens that permit the light beam to
16 converge at the micro-spots on the first and second substrates of the optical disk,
17 respectively.

1 140 (New) An optical disk apparatus including the compound objective lens
2 according to any one of claims 133-136, comprising:

3 (a): an optical head apparatus placed to face an optical disk including a first transparent
4 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
5 apparatus including:

6 (i): an optical source for radiating a light beam;

7 (ii): the compound objective lens receiving the light beam radiated by the optical
8 source so as to converge the light beam at micro-spots on the first and second substrates
9 of the optical disk, wherein the compound objective lens includes

10 a first region optimized so that the light beam passing the first region
11 converges at the micro-spots on the first substrate of smaller thickness of the
12 optical disk,

13 a second region optimized so that the light beam passing the second region
14 is converged at the micro-spots on any of the first and second substrates of the
15 optical disk, the second region including a hologram, and wherein

16 NA1 and NA2 are numeral apertures of the lens that permit the light beam
17 to converge at the micro-spots on the first and second substrates of the optical
18 disk, respectively, whereby T2>T1 and NA2<NA1;
19 (iii): focus control means for controlling focuses of the optical head apparatus
20 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
21 focuses being realized by the convergence of the light beam passing the first and second
22 regions of the compound objective lens;
23 (iv): tracking control means for performing a tracking control of the optical head
24 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
25 beam; and
26 (v): information detecting means for determining whether each of the substrates is
27 of thickness T1 or T2 and detecting pieces of information recorded on each determined
28 substrate on the basis of the light beam;
29 (b): moving means for moving the optical head apparatus;
30 (c): rotating means for rotating the optical disk; and
31 (d): reproducing means for reproducing the pieces of information detected by the
32 information detecting means upon a move of the optical head apparatus caused by the moving
33 means and a rotation of the optical disk caused by the rotating means.

1 141 (New). An optical disk information equipment including the compound objective
2 lens according to any one of claims 133-136, comprising:

3 (1) an optical disk apparatus, including:
4 (a): an optical head apparatus placed to face an optical disk including a first transparent
5 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
6 apparatus having:
7 (i): an optical source for radiating a light beam;
8 (ii): the compound objective lens receiving the light beam radiated by the optical
9 source so as to converge the light beam at micro-spots on the first and second substrates
10 of the optical disk, wherein the compound objective lens includes

11 a first region optimized so that the light beam passing the first region converges at
12 the micro-spots on the first substrate of smaller thickness of the optical disk,

13 a second region optimized so that the light beam passing the second region is
14 converged at the micro-spots on any of the first and second substrates of the optical disk,
15 the second region including a hologram, and wherein

16 NA1 and NA2 are numeral apertures of the lens that permit the light beam to
17 converge at the micro-spots on the first and second substrates of the optical disk,
18 respectively, whereby T2>T1 and NA2<NA1;

19 (iii): focus control means for controlling focuses of the optical head apparatus
20 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
21 focuses being realized by the convergence of the light beam passing the first and second
22 regions of the compound objective lens;

23 (iv): tracking control means for performing a tracking control of the optical head
24 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
25 beam; and

26 (v): information detecting means for determining whether each of the substrates is
27 of thickness T1 or T2 and detecting pieces of information recorded on each determined
28 substrate on the basis of the light beam;

29 (b): moving means for moving the optical head apparatus;

30 (c): rotating means for rotating the optical disk; and

31 (d): reproducing means for reproducing the pieces of information detected by the
32 information detecting means upon a move of the optical head apparatus caused by the moving
33 means and a rotation of the optical disk caused by the rotating means; and

34 (2) : an image signal generator for generating an image signal based on the reproduced
35 pieces of information.

1 142 (New). A computer system including the compound objective lens according to any
2 one of claims 133-136, comprising:

3 (1): optical disk apparatus, comprising:

4 (a): an optical head apparatus placed to face an optical disk including a first transparent
5 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
6 apparatus including:

7 (i): an optical source for radiating a light beam;
8 (ii): the compound objective lens receiving the light beam radiated by the optical
9 source so as to converge the light beam at micro-spots on the first and second substrates
10 of the optical disk, wherein the compound objective lens includes
11 a first region optimized so that the light beam passing the first region converges at
12 the micro-spots on the first substrate of smaller thickness of the optical disk,
13 a second region optimized so that the light beam passing the second region is
14 converged at the micro-spots on any of the first and second substrates of the optical disk,
15 the second region including a hologram, and wherein
16 NA1 and NA2 are numeral apertures of the lens that permit the light beam to
17 converge at the micro-spots on the first and second substrates of the optical disk,
18 respectively, whereby $T2 > T1$ and $NA2 < NA1$;
19 (iii): focus control means for controlling focuses of the optical head apparatus
20 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
21 focuses being realized by the convergence of the light beam passing the first and second
22 regions of the compound objective lens;
23 (iv) tracking control means for performing a tracking control of the optical head
24 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
25 beam; and
26 (v) information detecting means for determining whether each of the substrates is
27 of thickness T1 or T2 and detecting pieces of information recorded on each determined
28 substrate on the basis of the light beam;
29 (b): moving means for moving the optical head apparatus;
30 (c): rotating means for rotating the optical disk; and
31 (d): reproducing means for reproducing the pieces of information detected by the
32 information detecting means upon a move of the optical head apparatus caused by the moving
33 means and a rotation of the optical disk caused by the rotating means;

34 (2): a signal inputting unit for inputting pieces of information to be recorded on the
35 substrates;

36 (3): a central processing unit for processing the pieces of information recorded on the
37 substrates and processing the pieces of information to be recorded on the substrates; and

38 (4): a signal outputting unit for outputting the pieces of information recorded on the
39 substrates.

1 143 (New). The compound objective lens according to any one of claims 133-136,
2 configured for converging an incident light beam onto an optical disk including a first optical
3 disk of thickness T1 and a second optical disk of thickness T2, comprising:

4 a numerical aperture changer for satisfying the relationship $NA2 < NA1$, in which NA2 is
5 a numeral aperture of the second region to make the light beam converge onto the second optical
6 disk and NA1 is a numeral aperture of a region comprising the first region and the second region
7 to make the light beam converge onto the first optical disk.

1 144 (New). An optical head apparatus including the compound objective lens according
2 to any one of claims 133-136 for performing at least one of recording and reproduction of pieces
3 of information on to and from an optical disk placed to face the optical head apparatus, the
4 optical disk including a first transparent substrate of thickness T1 and a second transparent
5 substrate of thickness T2, the optical head apparatus comprising:

6 an optical source for radiating a light beam; and
7 the compound objective lens receiving the light beam radiated by the optical source so as
8 to converge the light beam at micro-spots on the first and second substrates of the optical disk;
9 and including first and second regions passing the light beam so that a numerical aperture
10 changer satisfies the relationship $NA2 < NA1$, in which NA2 is a numeral aperture of the second
11 region to make the light beam converge onto the second optical disk and NA1 is a numeral
12 aperture of a region comprising the first region and the second region to make the light beam
13 converge onto the first optical disk.

1 145 (New). An optical disk apparatus including the compound objective lens according to
2 any one of claims 133-136, comprising:

3 (a): an optical head apparatus placed to face an optical disk including a first transparent
4 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
5 apparatus comprising:

6 (i): an optical source for radiating a light beam;

7 (ii): the compound objective lens receiving the light beam radiated by the optical
8 source so as to converge the light beam at micro-spots on the first and second substrates
9 of the optical disk and including first and second regions passing the light beam so that a
10 numerical aperture changer satisfies the relationship $NA2 < NA1$, in which $NA2$ is a
11 numeral aperture of the second region to make the light beam converge onto the second
12 optical disk and $NA1$ is a numeral aperture of a region comprising the first region and the
13 second region to make the light beam converge onto the first optical disk;

14 (iii): focus control means for controlling focuses of the optical head apparatus
15 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
16 focuses being realized by the convergence of the light beam passing the first and second
17 regions of the compound objective lens;

18 (iv): tracking control means for performing a tracking control of the optical head
19 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
20 beam; and

21 (v): information detecting means for determining whether each of the substrates is
22 of thickness T1 or T2 and detecting pieces of information recorded on each determined
23 substrate on the basis of the light beam;

24 (b): moving means for moving the optical head apparatus;

25 (c): rotating means for rotating the optical disk; and

26 (d): reproducing means for reproducing the pieces of information detected by the
27 information detecting means upon a move of the optical head apparatus caused by the moving
28 means and a rotation of the optical disk caused by the rotating means.

1 146 (New). An optical disk information equipment including the compound objective
2 lens according to any one of claims 133-136, comprising:

3 (1) an optical disk apparatus, including:

4 (a): an optical head apparatus placed to face an optical disk including a first transparent
5 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
6 apparatus comprising:

7 (i): an optical source for radiating a light beam;

8 (ii): the compound objective lens receiving the light beam radiated by the optical
9 source so as to converge the light beam at micro-spots on the first and second substrates
10 of the optical disk, the compound objective lens including first and second regions
11 passing the light beam so that a numerical aperture changer satisfies the relationship
12 $NA_2 < NA_1$, in which NA_2 is a numeral aperture of the second region to make the light
13 beam converge onto the second optical disk and NA_1 is a numeral aperture of a region
14 comprising the first region and the second region to make the light beam converge onto
15 the first optical disk;

16 (iii): focus control means for controlling focuses of the optical head apparatus
17 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
18 focuses being realized by the convergence of the light beam passing the first and second
19 regions of the compound objective lens;

20 (iv): tracking control means for performing a tracking control of the optical head
21 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
22 beam; and

23 (v): information detecting means for determining whether each of the substrates is
24 of thickness T1 or T2 and detecting pieces of information recorded on each determined
25 substrate on the basis of the light beam;

26 (b): moving means for moving the optical head apparatus;

27 (c): rotating means for rotating the optical disk; and

28 (d): reproducing means for reproducing the pieces of information detected by the
29 information detecting means upon a move of the optical head apparatus caused by the moving
30 means and a rotation of the optical disk caused by the rotating means; and

31 (2): an image signal generator for generating an image signal based on the reproduced
32 pieces of information.

1 147 (New). A computer system including the compound objective lens according to any
2 one of claims 133-136, comprising:

3 (1) an optical disk apparatus, including:

4 (a): an optical head apparatus placed to face an optical disk including a first transparent
5 substrate of thickness T1 and a second transparent substrate of thickness T2, the optical head
6 apparatus comprising:

7 (i): an optical source for radiating a light beam;

8 (ii): the compound objective lens receiving the light beam radiated by the optical
9 source so as to converge the light beam at micro-spots on the first and second substrates
10 of the optical disk, the compound objective lens including first and second regions
11 passing the light beam so that a numerical aperture changer satisfies the relationship
12 NA2<NA1, in which NA2 is a numeral aperture of the second region to make the light
13 beam converge onto the second optical disk and NA1 is a numeral aperture of a region
14 comprising the first region and the second region to make the light beam converge onto
15 the first optical disk;

16 (iii): focus control means for controlling focuses of the optical head apparatus
17 correspondingly to the thicknesses of the substrates on the basis of the light beam, the
18 focuses being realized by the convergence of the light beam passing the first and second
19 regions of the compound objective lens;

20 (iv): tracking control means for performing a tracking control of the optical head
21 apparatus correspondingly to the thicknesses of the substrates on the basis of the light
22 beam; and

23 (v): information detecting means for determining whether each of the substrates is
24 of thickness T1 or T2 and detecting pieces of information recorded on each determined
25 substrate on the basis of the light beam;

26 (b): moving means for moving the optical head apparatus;

27 (c): rotating means for rotating the optical disk; and

28 (d): reproducing means for reproducing the pieces of information detected by the
29 information detecting means upon a move of the optical head apparatus caused by the moving
30 means and a rotation of the optical disk caused by the rotating means;

31 (2): a signal inputting unit for inputting pieces of information to be recorded on the
32 substrates;

33 (3): a central processing unit for processing the pieces of information recorded on the
34 substrates and processing the pieces of information to be recorded on the substrates; and

35 (4): a signal outputting unit for outputting the pieces of information recorded on the
36 substrates.